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AUTOMATIC POLICING AND INFORMATION SYSTEMS FOR INCREASING TRAFFIC LAW COMPLIANCE

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Noncompliance with traffic laws is severely impeding the safety of the road traffic system. According to an in-depth investigation of road accidents in France, 92% of traffic accidents are preceded by at least one traffic law violation (Rhodes, 1989). A review of the accident data bases in Europe (Van Opheusden, 1989) revealed that speed choice, violation of priority rules, driver state (i.e., drug use, alcohol, fatigue), lane discipline, and following distance are the driving practices most frequently contributing to vehicle accidents.

Traffic law enforcement can have a demonstrable effect on traffic law compliance (Rothengatter, 1982; Shinar & McKnight, 1985), which may lead to accident reductions of up to 20% for speed limit compliance alone (OECD, 1981). Unfortunately, police surveillance techniques and strategies are generally less than optimal (Østvik, 1989). As a result, traffic law violations are the rule rather than the exception on European roads: Observation studies have found that 80% of the drivers exceed the speed limit of 100 km/hr (60 mph) on divided highways (Rooijers, 1989), 50% of the drivers exceed the limit of 80 km/hr (50 mph) on rural roads (Rothengatter, 1988), and up to 80% of the drivers exceed the 50 km/hr (30 mph) limit on arterial roads in built-up areas (Rooijers, 1991). At intersections, up to 15% of the motorists, 25% of the cyclists, and 95% of the pedestrians have violated red lights, depending on factors such as traffic intensity and road layout (Oude Egberink & Rothengatter, 1984). Accordingly, a cross-cultural survey in four European countries revealed that most traffic law violations are not considered serious by the road users or by the police (De Bruin, Vaa, Østvik, & Rothengatter, 1990).

A major factor determining traffic law compliance is the subjective probability of detection when committing an offense. Although the mere presence of police vehicles can have transitory effects, the objective probability of detection appears to be the main determinant of the subjective likelihood of being caught (Rothengatter, De Bruin, & Rooijers, 1989). For this reason, efficient traffic law enforcement must maximize the objective probability of being caught. This probability can be increased considerably by using semiautomatic detection devices that detect the violation and register both violation and violator. Semiautomated devices such as radar or induction loop speed measurement coupled to a camera registering the license plate and the speed measured are in use in most European countries. Similar devices are being used for registering red light violations and the violation of stop signs (Harper & Nauwelaerts, 1990). On an experimental basis, automatic axle-weight detection is used to enforce heavy goods vehicle bans in residential areas (Ayland, in press). These systems have proved to be useful in increasing the objective probability of detection and are equally useful in corroborating the evidence presented by police officers in court cases. Essential to the successful implementation of such systems is that it be legally accepted that the vehicle owner is culpable for the offense committed with his or her car, irrespective of the question whether he or she was actually driving at the time the offense was committed. This is already common practice in some, but not all, European countries. Legal procedures severely limit the efficacy of semiautomated systems because of the long delay in informing a driver that he or she has been registered as having committed a traffic

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law violation. Moreover, electronically gathered information is accepted only as corroborative evidence; hence, a law officer must be called to court to testify.

These systems rely on the unobtrusive registration of the offense and do not inform the road user when a violation is recorded. Because feedback provisions have been a powerful means to increase compliance (e.g., Van Houten & Nau, 1983; Riedel, De Bruin, & Rothengatter, 1985), this should be considered an essential ingredient in automatic enforcement systems. It is also likely that providing feedback at the time the offense is committed (and preferably allowing the driver to correct his behavior before the offense is registered) will greatly increase the effect of the fine incurred. Thus, automatic enforcement should increase objective detection probability, provide immediate feedback to the driver, and immediately register and process any offense the driver commits.

To meet these requirements, automatic policing and information systems should fulfill several functions: (a) monitor road user behavior; (b) compare the behavior with the normative, required behavior; (c) provide feedback to the driver if there is a discrepancy between the monitored behavior and the required behavior, and that, if illegal behavior persists, the offense will be registered; and (d) procure evidence that an offense has been committed. Such systems could be located either on-site (e.g., at traffic lights) or in the vehicle, or both. On-site registration and information systems can detect the offense, register the offense, and provide feedback to the driver that he or she has committed an offense and that the offense has been registered. In addition, the recorded information can be fed into an automated offense-processing system. Basically, such systems are not very different from the semiautomated systems presently in use. However, they do offer the added advantage of providing drivers feedback about their behaviors at the moment the offense is committed. The disadvantage of such systems is that they do not allow drivers to correct their behaviors in order to avoid a citation, because these systems cannot repeatedly monitor the same driver. This is possible, however, with more elaborate in-vehicle systems that receive information from roadside beacons concerning the regulations relevant for the given situation and compare the required behavior with that required by the regulations. For example, roadside beacons could transmit the speed limit to a vehicle at any time a different speed limit is in effect or could transmit the required stop for a stop sign. Registration of the offenses committed can be realized with a "smart card" unit forming an integral part of the vehicle system. This smart card can be read by the police at regular intervals (e.g., when an extension of the driver's license or vehicle registration is required), or can be read by other parties, such as insurance companies, to assign premium payments or rebates.

Interactive systems involve the transmission of vehicle information to roadside registration and vehicle-to-vehicle data transmission. For example, when the vehicle system registers a deviation from normal vehicle handling, it informs the driver that he or she may be excessively fatigued or under the influence of alcohol or drugs and would at the same time transmit this information to a roadside beacon either to register the offense, or if there is any doubt, alert a police surveillance unit for further investigation. Vehicle-to-vehicle data transmission is relevant, for example, in establishing the priority rights at intersections or in establishing risky overtaking maneuvers.

Technically, all the above systems are feasible to implement within the near future. The more straightforward on-site systems can be implemented with currently available technology. The developments in electronic route guidance, driver support, and traffic management will require the implementation of vehicle-to-road and vehicle-to-vehicle communication systems in the next decade. It is argued here that such systems can also be used for automatic policing and driver feedback systems.

Before such systems are implemented several issues should be considered, particularly those related to road user acceptance and legal and privacy considerations. Offenses can be registered on the basis of automatic vehicle identification ("electronic license plate") or on the basis of the driver smart card information. From a technical standpoint, both

are equally feasible. In principle, road transport telematics offers a powerful means to monitor driver behavior and provide direct and immediate feedback to drivers whenever they commit an offense. Any effective police enforcement system, automatic or otherwise, will curtail drivers' freedom to violate traffic laws and avoid penalties and, for this reason, is not likely to be very acceptable. The acceptability balance can be redressed if obeying traffic laws becomes an attractive behavior. To increase acceptance, several schemes can be envisioned, including the provision of incentives by insurance companies and government agencies.

The purpose of this comment has been to draw attention to the technological possibilities that exist, or will exist in the near future, to change the contingencies of traffic law violations. Whether these will lead to actual behavior change in the driving populations has yet to be assessed. Another issue to be addressed is whether these behavior changes will indeed result in the reduction of accident occurrence, not only on an aggregate level but also among individual drivers. In this respect it may be useful to monitor specific groups of drivers (e.g., repeated offenders) over a longer period of time to establish the effects of automatic policing systems. Whether such systems will eventually be acceptable on a large scale depends primarily on the number of road traffic accidents considered acceptable by a society that determines the costs and benefits of potentially dangerous traffic law violations.

REFERENCES

Ayland, N. (in press). Automatic monitoring and enforcement of traffic highway violations. In K. Asp (Ed.), *Road safety and traffic environment in Europe*. Linköping: VTI.

De Bruin, R. A., Vaa, T., Østvik, E., & Rothengatter, J. A. (1990). *Drivers' attitudes to the seriousness of road traffic violations in four European countries*. Manuscript submitted for publication.

Harper, J., & Nauwelaerts, T. (1990). *Current technology: Reliability and implications for automatic policing*. Report 1033/D5 to the Commission of European Communities.

Organization for Economic Cooperation and Development. (1981). *The effects of speed limits on traffic accidents and transport use*. Dublin: An Foras Forbatha.

Østvik, E. (Ed.). (1989). *Police surveillance techniques and strategies*. Report 1033/D2 to the Commission of European Communities.

Oude Egberink, H. J. H., & Rothengatter, J. A. (1984). *Roodlichtnegatie van voetgangers op geregelde oversteekplaatsen* [Red light violations by pedestrians at traffic-regulated pedestrian crossings]. Report VK 84-05. Haren: Traffic Research Centre, University of Groningen.

Rhodes, S. (1989). *Approche qualitative des infractions generatrices d'accidents* [A qualitative approach to accident contributory traffic law violations]. Aix-en-Provence: CETE Mediterranée.

Riedel, R. A., De Bruin, R. A., & Rothengatter, J. A. (1985). *De invloed van intensiteit van verkeerstoezicht en variable bebording op het snelheidsgedrag op 80 km-wegen* [The effects of police surveillance intensity and variable message signs on speed choice on 80 km/h roads]. Report VK 85-19. Haren: Traffic Research Centre, University of Groningen.

Rooijers, A. J. (1989). *Meningen en motieven van automobilisten ten aanzien van rijsnelheid op autosnelwegen* [Opinions and motives of drivers with regard to driving speed on divided highways]. Report VK 89-03. Haren: Traffic Research Centre, University of Groningen.

Rooijers, A. J. (1991). *Beïnvloeding van het snelheidsgedrag binnen de bebouwde kom* [Influencing speed choice within built-up areas]. Report VK 91-01. Haren: Traffic Research Centre, University of Groningen.

Rothengatter, J. A. (1982). The effects of police surveillance and law enforcement on driver behaviour. *Current Psychological Reviews*, **2**, 349–358.

Rothengatter, J. A. (1988). Risk and the absence of pleasure: A motivational approach to modelling road user behaviour. *Ergonomics*, **31**, 599–607.

Rothengatter, J. A., De Bruin, R. A., & Rooijers, A. J. (1989). The effects of publicity campaigns and police surveillance on the attitude-behaviour relationship in different groups of road users. In N. Muhlrad (Ed.), *Proceedings of the second European workshop on recent developments in road safety research* (pp. 197–202). Arcueil: INRETS.

Shinar, D., & McKnight, A. J. (1985). The effects of enforcement and public information on compliance. In L. Evans & R. C. Schwing (Eds.), *Human behavior and traffic safety* (pp. 385–414). New York: Plenum.

Van Houten, R., & Nau, P. A. (1983). Feedback interventions and driving speed: Parametric and comparative analysis. *Journal of Applied Behavior Analysis*, **16**, 253–281.

Van Opheusden, P. (1989). *Analysis of accident databases*. Traffic Research Centre Report 1033/R5. Haren: University of Groningen.

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